ISSN (print) 0093-4666 © 2011. Mycotaxon, Ltd. ISSN (online) 2154-8889

MYCOTAXON

Volume 116, pp. 13–20 DOI: 10.5248/116.13

Wood-rotting fungi in eastern China 6. Two new species of *Antrodia* (*Basidiomycota*) from Mt. Huangshan, Anhui Province

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Abstract — Two new polypores, *Antrodia bambusicola* and *A. huangshanensis* from Mt. Huangshan in Anhui Province, eastern China, are described and illustrated. *Antrodia bambusicola* is characterized by its annual, resupinate and thin basidiocarps, regular pores with white to cream or pale buff-yellow pore surface, ellipsoid basidiospores, branched and septate cystidioles, and its growth on fallen *Bambusa* spp. *Antrodia huangshanensis* has resupinate to rarely effused-reflexed basidiocarps with cream pore surface, larger pores, branched and flexuous hyphae at dissepimental edges, and cylindrical to allantoid basidiospores; it was found on a fallen branch of *Pinus massoniana*, causes a brown rot, and prefers a dry environment.

Key words — brown-rot fungi, *Fomitopsidaceae*, taxonomy

Introduction

Karsten (1879) established the genus *Antrodia* P. Karst.; its species typically have an annual to perennial growth habit, resupinate to effused-reflexed basidiocarps, a dimitic hyphal system with clamped generative hyphae, hyaline, thin-walled and usually cylindrical to oblong-ellipsoid basidiospores that are negative in Melzer's reagent, and cause brown rot (Bernicchia & Ryvarden 2001, Gilbertson & Ryvarden 1986, Núñez & Ryvarden 2001, Ryvarden & Gilbertson 1993). It is a large cosmopolitan genus with more than 45 species (Kirk et al. 2008) of which 20 have been recorded from China (Dai & Niemelä 2002, Dai & Penttilä 2006, Dai et al. 2006, 2007a, b, 2009, Du et al. 2009, Li et al. 2008).

Recent studies on diversity of wood-rotting fungi in eastern China have revealed several new species (Cui & Dai 2008, Cui et al. 2008, Wang et al. 2009). During a study on wood-rotting fungi from the Mt. Huangshan National Park (Anhui Province), two species representing the brown rot genus *Antrodia* were found that could not be referred to any known species. They are described in the present paper as *A. bambusicola* and *A. huangshanensis*.

Materials & methods

The studied specimens were deposited in the herbarium of Beijing Forestry University (BJFC). The microscopic procedure follows Du & Cui (2009). In presenting the variation in the size of the spores, 5% of measurements were excluded from each end of the range, and given in parentheses. In the text the following abbreviations are used: IKI = Melzer's reagent, IKI– = negative in Melzer's reagent, KOH = 5% potassium hydroxide, CB = Cotton Blue, CB– = acyanophilous, L = mean spore length (arithmetic average of all spores), W = mean spore width (arithmetic average of all spores), Q = variation in the L/W ratios between the specimens studied, n = number of spores measured from given number of specimens. Sections were studied at magnification up to ×1000 using a Nikon Eclipse E 80i microscope and phase contrast illumination. Drawings were made with the aid of a drawing tube. Special colour terms follow Anonymous (1969) and Petersen (1996).

Taxonomy

Antrodia bambusicola Y.C. Dai & B.K. Cui, **sp. nov.** Fig. 1

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Carpophorum annuum, resupinatum; facies pororum bubalina vel luteola, pori rotundi vel angulati, 3 per mm. Systema hypharum dimiticum, hyphae generatoriae fibulatae, hyphae skeletales contexti 2.2–3.5 µm. Sporae hyalinae, ellipsoideae, IKI–, CB–, 5–6 × 3–3.4 µm.

Type. — China. Anhui Province, Huangshan County, Mt. Huangshan National Park, on fallen trunk of *Bambusa* sp. (*Poaceae*), 21.X.2010 Dai 11901 (**holotype** in BJFC).

Etymology — *bambusicola* (Lat.) refers to growing on bamboo.

Fruitbody — Basidiocarps annual, resupinate, adnate, corky, without odour or taste and light in weight when dry, up to 40 cm or more in longest dimension, 5 cm wide, and up to 0.5 mm thick at centre; sterile margin thinning out, membranous, white, up to 3 mm wide. Pore surface white to cream when fresh, becoming cream to pale buff-yellow when dry; pores round to angular, about 3 per mm; dissepiments thin, entire. Subiculum very thin to almost lacking, cream, less than 0.1 mm thick. Tubes concolorous with pore surface, corky, up to 0.4 mm long.

Hyphal structure — Hyphal system dimitic; generative hyphae bearing clamp connections, skeletal hyphae IKI–, CB–; tissue unchanged in KOH.

Subiculum — Generative hyphae scanty, hyaline, thin-walled, occasionally branched, 2–3.3 µm in diam; skeletal hyphae dominant, hyaline, distinctly thick-walled to subsolid, usually unbranched, interwoven, 2.2–3.5 µm in diam.

Tubes — Generative hyphae infrequent, hyaline, thin-walled, occasionally branched, 1.8–3 µm in diam; skeletal hyphae dominant, hyaline, distinctly thick-walled to almost solid, usually unbranched, some of them at dissepiment edge occasionally inflated, loosely interwoven, 2–3.8 µm in diam. Cystidia absent; cystidioles present, fusoid, hyaline, mostly thin- walled, occasionally slightly thick-walled, with a basal clamp connection, usually branched and

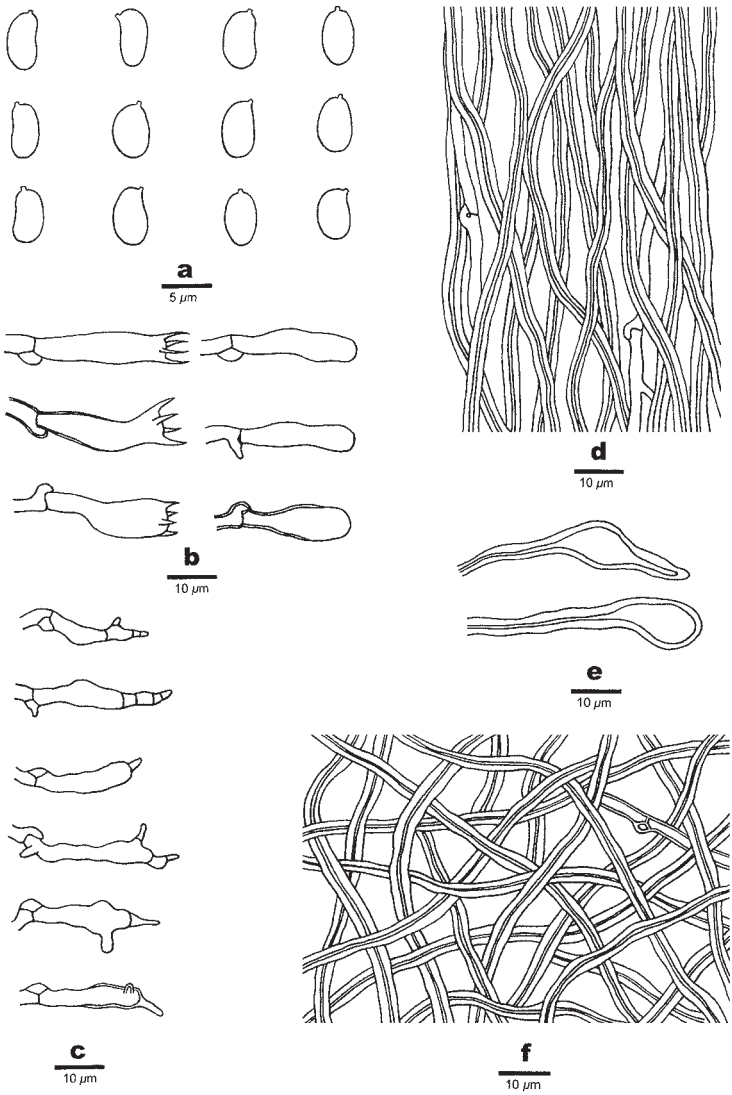

Fig. 1. Microscopic structures of *Antrodia bambusicola* (drawn from the holotype). a: Basidiospores. b: Basidia and basidioles. c: Cystidioles. d: Hyphae from trama. e: Inflated skeletal hyphae. f: Hyphae from subiculum.

with one to several secondary septum (septa), 16–25 × 4–6 μm; basidia clavate, bearing four sterigmata and a clamp connection at the base, 18–26 × 5–7 μm; basidioles in shape similar to basidia, but slightly smaller.

Spores — Basidiospores ellipsoid, hyaline, thin-walled, smooth, IKI–, CB–, (4.7–)5–6(–7) × (2.9–)3–3.4(–3.9) μm, L = 5.34 μm, W = 3.13 μm, Q = 1.71 (n=30/1).

Type of rot — Brown rot.

Additional specimen examined — **CHINA. Anhui Province**, Huangshan County, Mt. Huangshan National Park, on fallen trunk of *Bambusa* sp., 12.X.2004 Dai 6086 (BJFC).

Remarks — *Antrodia bambusicola* is characterized by its annual, resupinate and very thin basidiocarps, regular pores (usually 3 per mm) with white to cream or pale buff-yellow pore surface, ellipsoid basidiospores (5–6 × 3–3.4 μm), presence of branched and septate cystidioles, and by growth on *Bambusa* spp.

Morphologically, *A. bambusicola* is somewhat similar to species of *Ceriporia* Donk; however, species of *Ceriporia* have a monomitic hyphal system with simple septate generative hyphae, and cause a white rot (Núñez & Ryvarden 2001), while *A. bambusicola* has a distinct dimitic hyphal system with clamped generative hyphae, and causes a brown rot.

Antrodia vaillantii (DC.) Ryvarden has similar pores (2–4 per mm) and basidiospores (5–8 × 3–4 μm) as *A. bambusicola* but differs by having thicker and separable basidiocarps with a soft-fibrous margin, an absence of cystidioles, and growth on gymnosperm wood (Gilbertson & Ryvarden 1986).

Antrodia huangshanensis Y.C. Dai & B.K. Cui, **sp. nov.** Fig. 2

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Carpophorum annuum, resupinatum vel effuso-reflexum; facies pororum nivea vel cremea; pori rotundi vel angulati, 1–3 per mm. Systema hypharum dimiticum, hyphae generatoriae fibulatae, hyphae skeletales contexti 2.4–5.3 μm in diam. Sporae hyalinae, cylindricae vel allantoideae, IKI–, CB–, 5–6.5 × 1.6–2 μm.

Type. — China. Anhui Province, Huangshan County, Mt. Huangshan National Park, on fallen branch of *Pinus massoniana* Lamb. (*Pinaceae*), 11.X.2004 Dai 6082 (**holotype** in BJFC).

Etymology — *huangshanensis* (Lat.) refers to the locality of Mt. Huangshan.

Fruitbody — Basidiocarps annual, mostly resupinate, rarely effused-reflexed, tightly attached on the substrate, corky to leathery when fresh, hard corky and light in weight when dry, without odour or taste, pilei very narrow, projecting up to 2 mm, resupinate part up to 7 cm long, 3 cm wide, and up to 6 mm thick at centre. Pileal surface white when fresh, becoming cream when dry, glabrous; margin acute, sterile margin of resupinate part very narrow to almost lacking. Pore surface white to cream when fresh, becoming cream to cream-buff upon drying; pores round to angular, 1–3 per mm; dissepiments thin, mostly entire, sometimes slightly lacerate. Subiculum cream, corky, thin, ca. 1 mm thick. Tubes concolorous with pore surface, hard corky, up to 5 mm long.

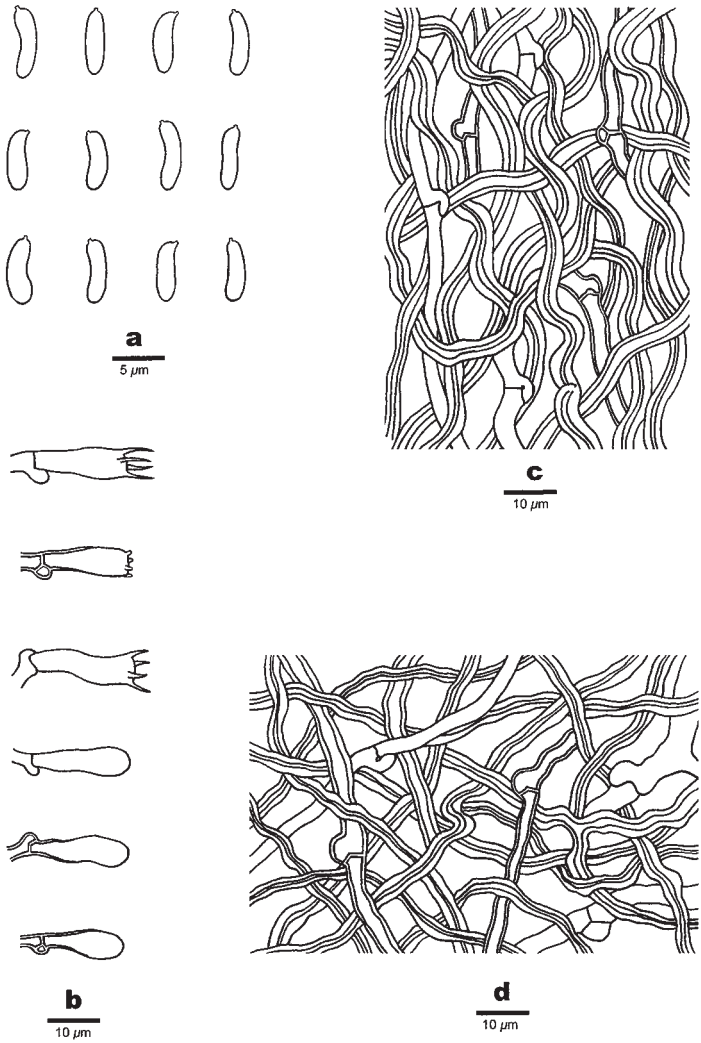

Fig. 2. Microscopic structures of *Antrodia huangshanensis* (drawn from the holotype). a: Basidiospores. b: Basidia and basidioles. c: Hyphae from trama. d: Hyphae from subiculum.

Hyphal structure — Hyphal system dimitic; generative hyphae bearing clamp connections, skeletal hyphae IKI–, CB–; tissue unchanged in KOH.

Subiculum — Generative hyphae frequent, hyaline, thin- to slightly thick-walled, occasionally branched, frequently septate with clamp connections,

2–5.1 μm in diam; skeletal hyphae thick-walled, flexuous, occasionally branched, interwoven, 2.4–5.3 μm in diam.

Tubes — Generative hyphae common, hyaline, thin- to slightly thick-walled, occasionally branched, 1.7–4.8 μm in diam; skeletal hyphae dominant, thick-walled to subsolid, straight to flexuous, moderate branched, interwoven, 2.2–5 μm in diam; hyphae at dissepimental edges usually branched and flexuous. Cystidia and cystidioles absent; basidia clavate, with four sterigmata and a basal clamp connection, 14.2–19.7 × 4–6 μm, basidioles in shape similar to basidia, but slightly smaller.

Spores — Basidiospores cylindrical to allantoid, hyaline, thin-walled, smooth, IKI–, CB–, (4.8–)5–6.5(–7.3) × (1.5–)1.6–2(–2.2) μm, L = 5.64 μm, W = 1.84 μm, Q = 2.95–3.26 (n=90/3).

Type of rot — Brown rot.

Additional specimens examined — **CHINA. Anhui Province**, Huangshan County, Mt. Huangshan National Park, on fallen branch of *Pinus massoniana,* 11.X. 2004 Dai 6081 (BJFC); 12.X.2004 Dai 6124 (BJFC).

Remarks — *Antrodia huangshanensis* is characterized by its resupinate to rarely effused-reflexed basidiocarps with white to cream pore surface, larger pores (1–3 per mm), branched and flexuous hyphae at dissepimental edges, cylindrical to allantoid basidiospores (5–6.5 × 1.6–2 μm), and growth on branches of *Pinus massoniana*. A brown rot fungus, it prefers a dry environment.

Morphologically, the new species resembles species of *Postia* Fr. with an annual growth habit, cylindrical to allantoid basidiospores, and causing a brown rot. *Postia,* however, is characterized by a monomitic hyphal system.

Antrodia sinuosa (Fr.) P. Karst. also produces resupinate to effused basidiocarps and larger pores (1–3 per mm) but its pale sordid brown pore surface when dry, sinuous pores with strongly lacerate to split dissepiments when mature, fusoid cystidioles, and relatively smaller basidiospores (4–6 × 1–2 μm, Ryvarden & Gilbertson 1993) distinguish it from *A. huangshanensis*.

Antrodia hingganensis Y.C. Dai & Penttilä from Heilongjiang and Jilin provinces in northeast China, which may be confused with both *A. sinuosa* and *A. huangshanensis,* is differentiated by smaller pores (3–5 per mm) and basidiospores (4–5.4 × 1.1–1.5 μm, Dai & Penttilä 2006).

Antrodia pseudosinuosa A. Henrici & Ryvarden from England has pores similar in size (1–2 per mm) to *huangshanensis* but is distinguished by its pileate basidiocarps, larger (6–7 × 1.8–2.2 μm) basidiospores, and growth on angiosperm wood (Henrici & Ryvarden 1997).

Antrodia albobrunnea (Romell) Ryvarden produces similarly sized basidiospores, but is characterized by a brown zone in its subiculum, smaller (3–5 per mm) pores, and distribution in temperate and boreal forests.

Antrodia huangshanensis may also be confused with *A. ramentacea* (Berk. & Broome) Donk in pore size and growth on *Pinus,* but the latter species has bigger basidiospores (9–11 × 4.5–5 µm, Ryvarden & Gilbertson 1993).

Other specimens examined. — ***Antrodia albobrunnea.*** **FINLAND**. Sompion Lappi, Pelkosenniemi, Luosto, on rotten wood of *Picea*, 3.VIII.1998 Dai 2747 (IFP); Koillismaa, Oulanka National Park, on charred wood of *Pinus,* 19.IX.1997 Dai 2710 (IFP).

— ***A. hingganensis.*** **CHINA**. **Heilongjiang Province**, Yichun, Fenglin Nature Reserve, on fallen trunk of *Larix,* 9.IX.2002 Dai 3748 (IFP & H); on fallen wood of *Picea*, 29.VII.2000 Penttilä 13011 (H); on fallen trunk of *Pinus,* 2.VIII.2000 Penttilä 13146 (H); **Jilin Province**, Antu County, Changbaishan Nature Reserve, on charred wood of *Abies,* 28.VII.1993 Dai 817 (IFP & H); on fallen trunk of *Pinus*, 14.IX.1998 Dai 2909 (IFP & H).

— ***A. sinuosa***. **FINLAND**. Uusimaa, Kirkkonummi, Jorvas, Finnträsk, on fallen trunk of *Pinus,* 24.VI.1993 Niemelä 5662 & Renvall (H); Sompion Lappi, Pelkosenniemi, Luosto, Kapusta, on charred wood of *Pinus*, 14.VIII.1998 Dai 2844 (IFP); Etelä-Häme, Lammi Biological Station, on charred wood of *Pinus,* 11.IX.1997 Dai 2605 (IFP).

Acknowledgements

We express our gratitude to Drs. Zheng Wang (USA) and Hai-Sheng Yuan (China) who reviewed the manuscript. The research was financed by the National Natural Science Foundation of China (Project No. 30900006 and 30910103907) and the Fundamental Research Funds for the Central Universities.

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